

Serial No. 10/714,457

Atty. Docket No. 277/026

Supp. Amendment dated September 1, 2005

Reply to Office action of April 22, 2005

**AMENDMENTS TO THE CLAIMS:**

Following is a listing of all claims in the present application, which listing supersedes all previously presented claims:

**Listing of Claims:**

1. (Previously Presented) A 2×2 optical switching apparatus using photonic crystal structures, the apparatus comprising:  
an optical-guide module having a first, a second, a third and a fourth waveguide, the first and the second waveguides guiding a first optical signal of a first input port to a first and a second output port, respectively, the third and the fourth waveguides guiding a second optical signal of a second input port to the second and the first output ports, respectively, and formed with photonic crystals having a complete photonic bandgap for a wavelength range of the first and the second optical signals; and  
a switching control section controlling the first and the second optical signals to be respectively guided through any one route of a first/third waveguide route and a second/fourth waveguide route, according to a route-selecting-control signal inputted from outside the 2×2 optical switching apparatus, input ports and output ports being adjacent for both the first/third waveguide route and the second/fourth waveguide route.
2. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 1, wherein the optical-guide module and the switching control section are formed as a single body.
3. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 1, wherein the switching control section comprises:  
a first pair of switching-control segments wherein each one of the first pair is positioned in an inner area of a respective one of the first and the third waveguides; and  
a second pair of switching-control segments wherein each one of the second pair is positioned in an inner area of a respective one of the second and the fourth waveguides;  
wherein  
any one pair of the first pair and the second pair of switching-control segments is selectively operated according to the route-selecting-control signal.

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4. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 1, wherein the switching control section further comprises:  
a photonic crystal having a controllable photonic bandgap; and  
a refractive index changing section for varying a refractive index of an inner substance of the photonic crystal according to the route-selecting-control signal.

5. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 4, wherein the refractive index changing section comprises:  
a temperature control section for outputting temperature control signals for controlling a temperature of the inner substance of the photonic crystal according to the route-selecting-control signal; and  
at least one heating device for changing the temperature of the inner substance of the photonic crystal according to the temperature control signals.

6. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 4, wherein the refractive index changing section comprises:  
an electric field control section for outputting electric field control signals for controlling an electric field intensity of the inner substance of the photonic crystal according to the route-selecting-control signal; and  
at least one electrode plate for controlling an electric field of the inner substance of the photonic crystal according to the electric field control signals.

7. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 4, wherein the refractive index changing section comprises:  
an optical intensity control section for outputting optical intensity control signals for controlling an intensity of optical signals to be applied to the inner substance of the photonic crystal according to the route-selecting-control signal; and  
at least one optical source for applying optical signals having the intensity corresponding to the optical intensity control signals to the inner substance of the photonic crystal.

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8. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 1, wherein the switching control section further comprises:  
two pairs of photonic crystals having a complete photonic bandgap for a wavelength range of the first and the second optical signals; and

a drive section for inserting and removing the two pairs of photonic crystals into and from the first, the second, the third and the fourth waveguides, respectively, according to the route-selecting-control signal.

9. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 8, wherein the drive section for inserting and removing the two pairs of photonic crystals inserts each one of one pair of the photonic crystals into a respective one of each of the first and the third waveguides, and removes each one of the other pair of the photonic crystals from each of the second and the fourth waveguides, respectively.

10. (Original) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 8, wherein the drive section for inserting and removing the two pairs of photonic crystals removes each one of one pair of the photonic crystals from each of the first and third waveguides, respectively, and inserts each one of the other pair of photonic crystals into a respective one of each of the second and the fourth waveguides.

11. (Previously Presented) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 2, wherein the switching control section is positioned where none of the first through fourth waveguides overlap.

12. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 1, wherein the first and third waveguide routes are not orthogonal and the second and fourth waveguide routes are not orthogonal.

13. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 1, the first through fourth waveguides each including a portion having a real slope.

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14. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 1, the first through fourth waveguides each including a portion having a curve.

15. (New) A 2×2 optical switching apparatus using photonic crystal structures, the apparatus comprising:

a first input port and a second input port located opposite to each other;

a first output port located adjacent the first and the second input ports;

a second output port located opposite to the first output port;

a photonic crystal optical-guide comprising a first waveguide route guiding a first optical signal of the first input port to the first output port, a second waveguide route guiding the first optical signal of the first input port to the second output port, a third waveguide route guiding a second optical signal of the second input port to the second output port, and a fourth waveguide route guiding the second optical signal of the second input port to the first output port, the photonic crystal optical-guide having complete a complete photonic bandgap for a wavelength range of the first and the second optical signals; and

a switching control section controlling the first and the second optical signals to be respectively guided through any one route of a first/third waveguide route and a second/fourth waveguide route, according to a route-selecting-control signal inputted from outside the 2×2 optical switching apparatus.

16. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 15, wherein the optical-guide and the switching control section are formed as a single body.

17. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 16, wherein the switching control section is positioned where none of the first through fourth waveguides overlap.

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18. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 15, wherein the first and third waveguide routes are not orthogonal and the second and fourth waveguide routes are not orthogonal.

19. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 15, the first through fourth waveguides each including a portion having a real slope.

20. (New) The 2×2 optical switching apparatus using photonic crystal structures as claimed in claim 15, the first through fourth waveguides each including a portion having a curve.